Detection of Alzheimer's protein biomarker Clusterin using Graphene transducers

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Worldwide prevalence of dementia is estimated to rise from the current 50 million people affected to 152 million by 2050, costing healthcare systems ~2% of the global GDP to diagnose, treat and care for patients [1]. Although there are over 130 different types of dementia, Alzheimer's disease (AD) accounts for 60-70% of all cases. Methods for early diagnosis of AD could significantly impact disease detection, progression monitoring and therapeutics. Meeting this need requires sensitive and specific sensors to detect concentration level changes in patients significantly earlier than current diagnostic techniques employing MRI, PET scans etc. We have therefore developed novel graphene transducers for the sensitive detection of AD protein biomarkers, such as Clusterin a molecular chaperone associated with AD, using electrical admittance spectroscopy. The graphene transducers [2] were fabricated on Si/SiO_2 substrate using photolithography with evaporated chromium and sputtered gold contacts. The transducer channels were functionalized with linker molecules, 1-Pyrenebutyric acid *N*-hydroxysuccinimide (Pyr-NHS) ester, to immobile anti-Clusterin antibody (Ab) [3]. Binding reaction of the antibody with varying concentration levels of Clusterin antigen demonstrated the limit of detection of the transducers to be better than 1 pg/mL using four-probe direct current-voltage (DC-IV) measurements [4,5]. The developed transducers are generic, selective, fast, low-cost and could find applications in a broad range of point-of-care medical diagnostics in addition to neurodegenerative diseases (Alzheimer's, Parkinson's, etc.), such as cancer and cardiovascular disorders. We acknowledge funding from the UK's EPSRC, EP/M006301/1 and University of Plymouth, GD105227.

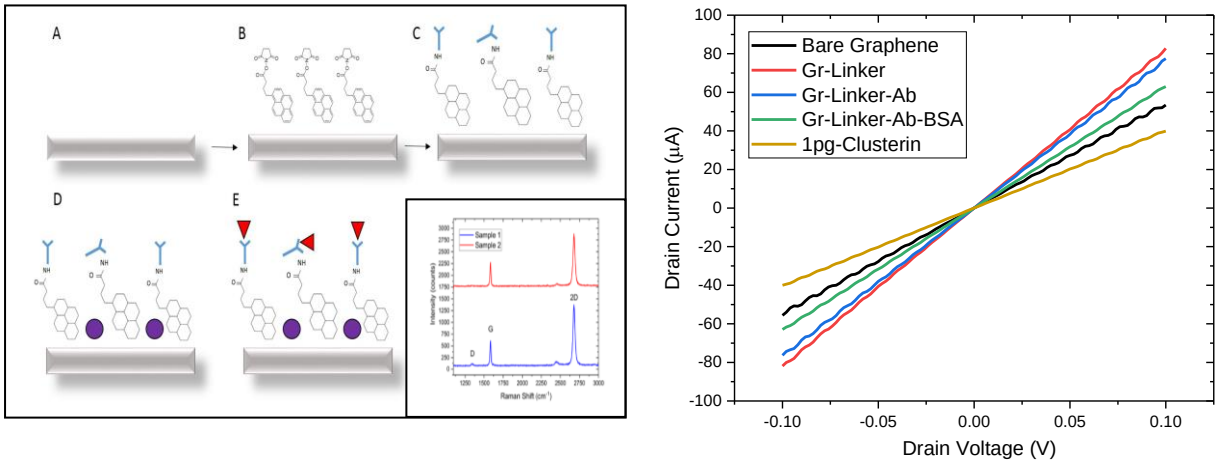

Fig. 1. Graphene device functionalisation *(A: Graphene/hBN, B: Pyr-NHS, C: Ab, D: Bovine Serum Albumin E: Clusterin)* with inset showing Raman spectra of the graphene channel (left) and detection of Clusterin at 1pg/mL concentration using DC 4-probe I-V electrical measurements (right).

References

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